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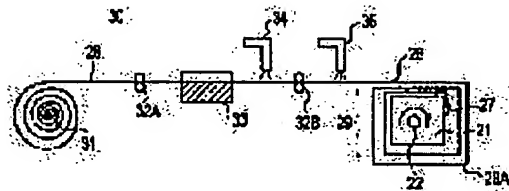
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**(54) LAMINATE TILE POLE PIECE FOR MRI DEVICE, AND METHOD AND DEVICE FOR MANUFACTURING LAMINATE TILE**

(57)Abstract:

**PROBLEM TO BE SOLVED:** To form a laminate pole piece which does not have an oddly shaped edge filler tile by winding a ribbon to a polygonal bobbin, bonding the spiral formed parts of the respective coils formed by winding a ribbon to a polygonal bobbin to the adjacent spiral form part of at least one of the coils, and cutting the coil into the forms of laminate tiles.

**SOLUTION:** The tip of a metal ribbon 28 is inserted between a clamp 27 and a polygonal bobbin 21, the bobbin 21 is rotated, the ribbon 28 is wound around the bobbin 21 and a coil having at least one almost planar part 29 is formed. The almost planar part of the coil is compressed by a pressure bar after the ribbon 28 is completely wound to the bobbin 21. Respective pressure bars are connected to a fluid pressure extrusion arm, and the extrusion arms move the pressure bar inward to the bobbin 21 and add pressure to the coil 28A. The eddy parts are bonded to the eddy part of at least one of the coils, the coil is cut in the forms of the laminate tiles and laminate bars are formed.

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DESCRIPTION OF DRAWINGS

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## [Brief Description of the Drawings]

- [Drawing 1] It is the plan of the conventional pole piece.
- [Drawing 2] It is the side cross section of the conventional pole piece cut with line X-X' of drawing 1.
- [Drawing 3] They are some perspective diagrams of the equipment by this invention.
- [Drawing 4] It is the front view of the equipment of drawing 3.
- [Drawing 5] It is the side elevation of the equipment of drawing 3.
- [Drawing 6] It is the cross section of a different winding frame cut with line A-A' of drawing 3.
- [Drawing 7] It is the cross section of a different winding frame cut with line A-A' of drawing 3.
- [Drawing 8] It is the cross section of a different winding frame cut with line A-A' of drawing 3.
- [Drawing 9] It is the side cross section which cut the winding frame with a coil with line B-B' of drawing 4.
- [Drawing 10] It is the front view with a coil of a winding frame.
- [Drawing 11] It is the cross section of the winding frame by another example of this invention.
- [Drawing 12] It is the schematic drawing of the equipment by the 1st example of this invention.
- [Drawing 13] It is the side elevation of the coil processed according to the method of this invention.
- [Drawing 14] It is the side elevation of the coil processed according to the method of this invention.
- [Drawing 15] It is the side elevation of the coil processed according to the method of this invention.
- [Drawing 16] It is the side elevation of the coil processed according to the method of this invention.
- [Drawing 17] It is the perspective diagram of the laminating tile by the 1st example of this invention.
- [Drawing 18] It is the plan of the laminating tile by the 1st example of this invention.
- [Drawing 19] It is the plan of the laminating tile by the 1st example of this invention.
- [Drawing 20] It is the perspective diagram of the laminating tile equipment by the 1st example of this invention.
- [Drawing 21] It is the plan of the laminating tile equipment by the 1st example of this invention.
- [Drawing 22] It is the side cross section which turned off the laminating tile equipment by the 1st example of this invention by C-C' of drawing 21.
- [Drawing 23] It is the side cross section of MRI equipment.
- [Drawing 24] It is the side cross section of MRI equipment.
- [Drawing 25] It is the schematic drawing of the equipment by the 2nd example of this invention.
- [Drawing 26] It is the schematic drawing of the equipment by the 2nd example of this invention.
- [Drawing 27] It is the perspective diagram of the laminating tile by the 3rd example of this invention.
- [Drawing 28] It is the side cross section of the MRI equipment by the 3rd example of this invention.
- [Drawing 29] It is the side cross section of the MRI equipment by the 3rd example of this invention.
- [Drawing 30] It is the plan of the pole piece by the 3rd example of this invention.
- [Drawing 31] It is the perspective diagram of the laminating tile by the 4th example of this invention.
- [Drawing 32] It is the perspective diagram of the laminating tile by the 4th example of this invention.
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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the laminating tile for MRI pole pieces at the method of manufacturing a laminating tile and equipment, and a list.

[0002]

[Background of the Invention] Recently, the so-called laminating tile pole piece for MRI was developed. In order to consider such development, the plan of a laminating tile pole piece is shown in drawing 1, and the side elevation is shown in drawing 2. The pole piece 10 is formed in accordance with the circumference of the circular substrate 11 of soft iron, and a substrate 11, and has the soft iron ring 12 which dispatches magnetic flux to the crevice between magnets, the laminating tiles 13 and 14 of an elasticity ferrite, and the core 15 of the soft iron for attaching an inclination magnet coil. The laminating tile 14 in the core of a substrate 11 has thickness still larger than the laminating tile 13 in the periphery section of a substrate 11, and forms the projection 16 of a convex form. The projection 16 of a convex form improves the uniformity of a magnetic field.

[0003] However, the conventional laminating tile pole piece has some defects. Laminating tiles 13 and 14 most to the 1st are a rectangular head or a rectangle. On the other hand, the substrate 11 and the ring 12 are circular. Therefore, in order to insert in the tile of a rectangular head or a rectangle into a circular opening, edge restoration tile 13A is required. As shown in drawing 1, each edge restoration tile 13A has a peculiar odd form, in order that the tile 13 of the periphery section may enable it to bury the circular substrate 11 and a ring 12 completely. Each edge restoration tile 13A must be formed independently [ other tiles 13 ], in order to make the peculiar form. This increases the cost and complexity of a process.

[0004] It is circular as projection 16 is also shown [ 2nd ] in drawing 1. Therefore, in order to arrange a rectangular head or the rectangular central tile 14 in a circle, as shown in drawing 1 and 2, edge restoration tile 14A is required. Edge restoration tile 14A also has a peculiar odd form, in order that the tile 14 of a core may enable it to form the circular projection 16. Furthermore, in order to insert in the tile 14 of a core with the tile 13 of the periphery section and to make it put together [ tile / without leaving a crevice ], edge restoration tile 14A must also have two different thickness, as shown in drawing 2. Each edge restoration tile 14A with a peculiar form must also be formed independently [ the tile 14 of other cores ]. This increases the cost of a process further.

[0005] The conventional method of forming the laminating tile according to individual in the 3rd is based on the pile of powder-metallurgy processing or the metal ribbon of handicraft. For example, a certain conventional powder-metallurgy-processing laminating tile method needs to compress powder and to form a tile layer, after pouring in metal powder into the mold according to individual. The laminating tile is formed by pasting up the \*\*\*\* tile layer according to individual on other tile layers. By another conventional method, a thin metal sheet is shredded to a thin strip, the strip which covered each strip with a cover and epoxy with epoxy is accumulated according to an individual, and the laminating bar is formed. Next, a laminating bar is carried to a compression equipment, and it compresses and

anneals there. And these bars are transported to cutting equipment and the laminating tile of a rectangular head is formed by cutting a laminating bar by the saw there. The accumulated bar is compressed and, instead, is made by temper \*\*\*\*\* in front of epoxy impregnation. Such batch need to transport the charge of a laminated wood to another station from a certain station, and need the handicraft of \*\*\*\*\*. This is because the metal layer of hundreds of sheets must be accumulated by hand. They have \*\*\*\* out of which a difference comes between the activities of each time of this method while such methods tend to be complicated, tend to require costs and tend to form the defective tile for the humane error.

[0006]

[Summary of the Invention] It is desirable by forming a laminating tile pole piece without the edge restoration tile of an odd form in view of having stated above to lessen the cost and complexity of the manufacture method. This invention offers the laminating tile pole piece for magnetic resonance imaging. This pole piece consists of laminating tiles of two or more trapezoids arranged so that the ring of two or more of these hearts might be accomplished, or an annular sector. A laminating tile twists a ribbon around a polygon winding frame, forms a coil, pastes up each spiral shape portion of a coil on at least one adjoining spiral shape portion of a coil, and is formed by cutting a coil in the form of a laminating tile.

[0007] While making the effort to need into the minimum, it is also desirable to offer the easy and cheap continuous laminating tile manufacture method that the result which has consistency in time amount as \*\* is brought about. This invention also offers the method of manufacturing a laminating tile. this method -- a polygon winding frame -- a ribbon -- twisting -- at least one abbreviation -- a coil with a flat portion is formed, each spiral shape portion of a coil is pasted up on the spiral shape portion which at least one coil adjoins, and it includes cutting a coil in the form of a laminating tile.

[0008] This invention also offers the equipment which enforces the laminating tile manufacture method. 1st means by which this equipment applies adhesives to a ribbon, and a ribbon -- twisting -- at least one abbreviation -- it has 2nd means to form a flat portion, and 3rd means to stiffen adhesives. furthermore, the container into which the adhesives with which this equipment covers a ribbon with adhesives were put and a ribbon -- twisting -- at least one abbreviation -- the polygon winding frame which forms a coil with a flat portion, and the heater which stiffens adhesives are included.

[0009]

[Detailed explanation of a desirable example] Some [ which manufactures a laminating tile according to this invention ] examples of equipment are shown in drawing 3 and 4-8. Drawing 3 is some perspective diagrams of equipment. Drawing 4 is front view and drawing 5 is some side elevations of the equipment shown in drawing 3 . The portion 20 of equipment has the polygon winding frame 21 with which the shaft 22 was equipped and which can be rotated. The portion 20 of equipment also has the winding frame side plates 23A and 23B and the pressure bars 24A, 24B, 24C, and 24D of optional selection. In order to make a drawing legible, the pressure bar is not shown in drawing 4 and 5. The shaft orientations of a shaft 22 are equipped with the winding frame 21 and the side plate 23, and they are held by the bond part material 25A and 25B in the predetermined location. When the screw thread is prepared in the edge which the shaft exposed and it acts as a bolt, each bond part material may be a nut. Bond part material may also have the washer held at the end of the shaft by friction, or the washer attached in the side plate with the screw thread. It is desirable that a winding frame 21 is equipped with side plates 23A and 23B with a bolt 26. The winding frame 21 also has the clamp or slit 27 for attaching a metal ribbon in a winding frame. As for a clamp 27, operating mechanically is desirable so that the looped-around metal ribbon (namely, stainless steel coil) can be released from a winding frame. Similarly, a pressure bar can be attached in a side plate with a screw thread. Side plates 23A and 23B may have opening 23' to which the operator of equipment enables it to observe the appearance of the metal ribbon around which a winding frame 21 is looped by optional selection.

[0010] Drawing 6 -8 is the cross section of the winding frame 21 cut with line A-A of drawing 3 . As shown in drawing 6 , as for a polygon winding frame, it is desirable to have a rectangular-head cross section. However, the cross section of the polygon winding frame 21 may be the polygon with at least

one flat side of arbitration, or the form of arbitration. For example, you may be a pentagon, an octagon, etc. which are demanded according to a triangle as the cross section of a winding frame shows to drawing 7 , a hexagon as shown in drawing 8 , or the form of a coil. The pressure bar 24 of the same number as the flat side of a polygon winding frame is formed. For example, if a winding frame is a hexagon cross section, six pressure bars should be prepared. Side plates 23A and 23B may have a form which may have the form of the same cross section as a winding frame 21, or is different. For example, a side plate may be circular.

[0011] As shown in drawing 4 and 5, as for side plates 23A and 23B, it is desirable that it is larger than a winding frame 21. If a side plate is still larger, a metal ribbon will be guided on a winding frame and telescopic-motion \*\*\*\*\* will be prevented for a ribbon from a winding frame.

[0012] Drawing 9 and 10 show the polygon winding frame 21 which looped the surroundings of it around the ribbon in the form of coil 28A. Drawing 9 is the cross section cut with line B-B of drawing 4 , and drawing 10 is the front view of a winding frame 21. The edge of coil 28A is held between the winding frame 21 and the clamp 27. coil 28A -- at least one "abbreviation -- it has flat partial"29. "abbreviation -- flat partial" has lapped with the flat portion of a polygon winding frame among coils, and means the portion in which only the part which curves outside from the condition that the surroundings of a winding frame are looped around a coil to a curled form has the field which shifts from a completely flat condition. In other words, even if the winding frame has a flat field, the coil twisted around the surroundings of a winding frame at the curled form has the field which may be rising highly a little from the center of the flat field of a winding frame more nearly up than the edge of the flat field of a winding frame. Coil 28A has the field where the same number as the flat side in a polygon winding frame is flat. As for coil 28A, it is desirable that it is a stainless steel coil like the amorphous iron coil used for the pole piece of MRI. However, the coil may be made from the paper used for other uses, or other materials like plastics. Preferably, the thickness of a ribbon is less than (namely, less than 5 mils) 5x10 - 3 inches, the thickness of a coil has 1 thru/or width of face of 30 inches by 0.1 thru/or 10 inches, and it is desirable 100 thru/or to be twisted around the surroundings of a winding frame 10000 times. For example, when a ribbon with a thickness of 1 mil is twisted around the surroundings of a winding frame 1000 times, as for a coil, thickness becomes [ width of face ] 1 inch by 8 inches. However, a ribbon and coils may be other sizes based on the final use demanded.

[0013] Furthermore, as shown in drawing 11 , polygon winding frame 21" may have the flat field where sizes differ. unsymmetrical coil 28A twisted around such a winding frame -- a long abbreviation -- flat partial 29A and a short abbreviation -- it has flat partial 29B. Then, when it needs the tile with which forms differ, unsymmetrical coil 28A can be cut, without making the charge of a coil strip useless in the case of plastic surgery so that a large laminating tile and a small laminating tile may be formed.

[0014] The example of the method of forming a laminating tile according to this invention and equipment 30 is explained about drawing 12 -19. As shown in drawing 12 , it \*\*\*\* and the delivery spool 31 is looped around the amorphous metal ribbon 28. It can cut and the metal ribbon 28 can form a metal sheet in predetermined width of face beating or by twisting it around spool 31. Instead, it may begin to pour on the wheel turning around a liquid metal, or the belt which moves, the amorphous ribbon 28 may be formed, and then that amorphous ribbon 28 may be twisted around spool 31. Then, a metal ribbon is sent out where tension is applied from spool 31. This tension can be applied with other well-known tension equipments in the field of a continuation web like Rollers 32A and 32B, a bar, or a lever.

[0015] Next, the bath of adhesives 33 lets the metal ribbon 28 pass. Adhesives are applicable to one side or the both sides of a ribbon 28. the roller with which adhesives were instead covered with adhesives -- or it is applicable to a ribbon 28 by all these methods from the adhesives distribution nozzle 34. Adhesives may consist of adhesives material of arbitration known for this field as a metal indirect arrival agent. Furthermore, a ribbon 28 can apply behind the front stirrup which applies adhesives to corona discharge 35 by optional selection, in order to strengthen the bond strength of a ribbon 28. Drawing 12 shows that some equipments are developed on a horizontal line. However, the portion from which equipment differs can be arranged at a mutually different angle, or can be arranged up and down to each

other. In this case, a ribbon 28 may pass along the surroundings of Rollers 32A and 32B by a certain angle.

[0016] The tip of the metal ribbon 28 is inserted between a clamp 27 and the polygon winding frame 21. then, a winding frame 21 is rotated -- making -- a ribbon -- the surroundings of a winding frame -- twisting -- at least one abbreviation -- a coil with the flat portion 29 is formed. A winding frame may make it rotate by the motor (not shown in drawing), or may make it rotate manually.

[0017] after a ribbon 28 is completely twisted around a winding frame 21, it is shown in drawing 13 -- as -- the abbreviation for a coil -- a flat portion is compressed by optional selection by pressure bar 24A-24D. While compressing a coil and controlling the thickness, adhesives are opened between each portion of a coil. pressure bar 24A-24D -- the abbreviation for a coil -- it is desirable to have the same form as the flat portion 29. for example, the abbreviation for a coil -- when the flat portion 29 has a rectangular surface area roughly, the pressure bar 24 which acts on the coil portion 29 should also be made the rectangle. however, the abbreviation for a coil -- the forms of a flat portion and a pressure bar may differ.

[0018] Pressure bar 24A-24D can be attached in side plates 23A and 23B with a bolt or a screw thread. When a screw thread is turned, a pressure bar is \*\*\*\*\* to coil 28A. Instead, pressure bars may be some automated equipment. Each pressure bar is connected to hydrostatic pressure extrusion arm 36A-36D with this equipment. Then, the extrusion arm controlled by the computer moves a pressure bar to the inside sense toward a winding frame 21, and applies a pressure to coil 28A.

[0019] Then, the adhesives between each portion of a coil are stiffened by applying the heat from a heat source 37. A heat source 37 can consist of a resistance heater, a heat lamp, or an RF coil. A heat source 37 can be attached in the inside or the outside of a wall 38 of equipment 31. Before adhesives apply a pressure to coil 28A, a rear stirrup can be stiffened in the meantime. Curing temperature is the function of the specific adhesives used.

[0020] Then, as shown in drawing 14 , it is desirable to release coil 28A from a winding frame 21. After demounting the bond part material 25A and 25B first, coil 28A demounts side plates 23A and 23B, and is released by carrying out the telescopic motion of the coil 28A from a winding frame 21. then, the area of a coil as shown in drawing 14 by the arrow head -- the abbreviation for a coil -- the flat portion 29 is cut from a coil and the laminating bar 40 shown in drawing 15 is formed. A coil can be cut by the well-known processing method of arbitration. For example, a circular saw 39, a band saw, or laser can cut coil 28A. The laminating bar 40 consists of portions which fixed with the adhesives hardened among the metal ribbons 29. Instead, a coil 28 can be cut, before demounting it from a winding frame 21.

[0021] Then, as shown in drawing 16 -19, the laminating bar 40 is orthopedically operated so that the laminating tile 42 may be formed with plastic surgery equipment 41. As for plastic surgery equipment 41, it is desirable that it is a water jet. However, other plastic surgery equipments may be used. Furthermore, without forming the laminating bar 40 first, coil 28A may be cut so that two or more laminating tiles 42 may be formed directly. As shown in drawing 17 and 18, as for the laminating tile 42, it is desirable to make it a trapezoid. However, as shown in drawing 19 , laminating tile 42' may be made into an annular sector. An annular sector is a trapezoid which has surface or shorter side 43' which is a concave, and has the convex lower side or long side 44'.

[0022] On a circular base, it arranges horizontally and a laminating tile is attached, as shown in drawing 20 . Drawing 20 is a notch \*\*\*\*\* perspective diagram in a part of base of a pole piece in which three pole piece laminating tiles 42 were attached. As for a laminating tile, it is desirable to attach in a base 51 and mutual with epoxy. One method of attaching the laminating tile 42 in a base 51 is indicated by the United States Patent application 09th of application / No. 198 or 57 on November 24, 1998, and it replaces with explanation by quoting the whole here.

[0023] As shown in drawing 21 and 22, the circular base 51 and the whole ring 52 are buried with the trapezoid laminating tile 42. A base 51 and a ring 52 may be called a "magnetic pole shoe." Instead, a ring 52 may be called "edge SIMM" by the case. Drawing 21 shows the plan of a pole piece 50, and drawing 22 shows the cross section cut with line C-C' of drawing 21 to this. A laminating tile is arranged so that the ring 53 of two or more of these hearts thru/or 62 may be accomplished. The



advantage of the laminating tile 42 being a trapezoid or an annular sector is clear from drawing 21 . All laminating tiles can have the same size and the same configuration. Therefore, although a base 51 and a ring 52 are buried, the edge restoration tile of an odd form is not needed. For this reason, the cost and complexity of a method which assemble a laminating tile pole piece decrease.

[0024] For example, the tile ring 53-57 of this heart near the center of a base 51 may make still larger than the tile rings 58, 60, and 61 of this heart near the periphery of a base 51 thickness (namely, height measured from the base 51), in order to form a projection near the center of a base 51. This projection does not need the edge restoration tile of an odd form. By optional selection, the rings 59 and 62 of this heart of the periphery section may have thickness still larger than the rings 58, 60, and 61 of the periphery section. Of course, other thickness and configurations of a ring are also possible. For example, even if there are more rings of this heart than ten pieces, they are good at least. All rings may be the same thickness and you may be different thickness. The simulation by the computer of the flow of the magnetic field between the magnets of the MRI equipment which passes along a pole piece 50 should determine the thickness of the number of rings, and a specific ring. You may be an iron core for the central ring 53 to instead attach an inclination magnet coil.

[0025] Furthermore, a ring can be formed by accumulating two or more laminating tiles 42 of each other. A thick ring can be constituted by making [ many ] the number of the accumulation tiles accumulated rather than a thin ring. By optional selection, the space between the crowning of the pole piece retaining ring 52 and a laminating tile can be fill uped with SIMM as indicated by the United States Patent application 09th of application / No. 178,320 on October 23, 1998. It replaces with explanation by quoting this whole United States Patent application here.

[0026] Since the thickness of a laminating tile is determined by the thickness of coil 28A, this invention is advantageous to especially forming the laminating tile with which thickness differs. The thickness of coil 28A is determined by the count which only twists a ribbon 28 around a winding frame 21. Therefore, what is necessary is just to twist a ribbon 28 many numbers of times by the surroundings of a winding frame 21, in order to form the tile for the rings of a thick core rather than the tile for the rings of the thin periphery section. For example, a tile thick [ for the rings of a core like a ring 53-57 ] can be formed by cutting the coil twisted around the surroundings of a winding frame 800 times by cutting the coil twisted around the surroundings of a winding frame 1000 times to the ability forming the thin tile for the rings of the periphery section like rings 58 and 60.

[0027] The magnetic field generator ("MRI equipment") used for magnetic resonance imaging by this invention, i.e., MRI, is shown in drawing 23 and 24. With two tabular yokes [ at least two ] 71A and 71B, the MRI equipment shown in drawing 23 has four pillar-shaped yokes 71C and 71D preferably. As shown in drawing 24 , instead, MRI equipment with one "C" form yoke 71 can be used. the pole piece bases 51 and 51 fixed to the magnet 72 with which MRI equipment was fixed to the yoke side, 72' and a magnet 72, and 72' -- it has 'the laminating tile pole pieces 74 and 74 fixed to the list by a retaining ring 52 and 52', and a pole piece base and a retaining ring'. A crevice 73 is formed between pole pieces. A imaging \*\*\*\* body portion is inserted in a crevice 73.

[0028] A magnet 72 and 72' can consist of electromagnets which twisted electric conduction or a super-electric conduction coil around the surroundings of a permanent magnet like RFeB, RCoFeB, or a SmCo magnet, or an iron core. MRI equipment may also have an inclination coil or SIMM as shown in drawing 23 and 24 by 75 and 75' by optional selection. Furthermore, by optional selection, MRI equipment may have a bakelite, synthetic resin, wood, or an insulating layer with small permeability like a ceramic between the base and the laminating tile, in order to reduce the remnant magnetism of a pole piece.

[0029] MRI equipment may also have the electronic circuitry 76 and the display 77. An electronic circuitry 76 can consist of/or memory in a control unit, a transmitter, a receiver, and an imaging instrument list.

[0030] The 2nd example of the method of manufacturing a laminating tile according to this invention and equipment is shown in drawing 25 . In this example, the ribbon delivery spool 31 is omitted and a ribbon 28 is manufactured between continuous processes within the same equipment 80 as coil 28A.

continuous process is advantageous at the point which decreases production time and ribbon spool migration cost. A metal or a metal alloy is fused with a crucible 81, and it begins to pour out of the orifice at the bottom of a crucible on a rotating wheel 82. As for a wheel 82, it is desirable to be cooled with the cooling water which passes along the inner circumference. The metal alloy which began to be poured out is solidified as a continuous amorphous ribbon 28, and this comes out from a wheel 82. A ribbon 28 is caught by roller 32C, and it lets it pass to the adhesives bath 33. The remaining production process is the same as the method and equipment which described drawing 12 -19 above. A crucible can be heated at an RF coil or the resistance heater 83. A liquid metal alloy can be extruded from a crucible by supplying pressurization inert gas from a pipe 84. Instead, a rotating wheel can be replaced at a migration belt.

[0031] As another whole surface of the 2nd example, a crucible can be formed as a bath instead of a pipe, as shown in drawing 26. The pan or tap 86 of a slack form begins to be filled with molten metal or the metal alloy 87 from the crucible 85 of the form of a bath. Then, molten metal flows on the quenching wheel 82 from the pan or tap 86 of a slack form, and forms a ribbon 28.

[0032] Furthermore, it can automate completely and the method explaining drawing 12 -19 and 25-26 can be controlled by the computer. The computer control system which controls continuous web equipment is well-known in this industry.

[0033] In drawing 17, the laminating of each class of a laminating is carried out along the height, i.e., thickness direction, of the laminating tile 42. However, in the 3rd example of this invention, as shown in drawing 27, along with the width of face of laminating tile 42", the laminating of each class 91, 92, 93, and 94 of a laminating is accumulated or carried out. the laminating tile 42 -- it is made by operating orthopedically in the form of 'trapezoid laminating tile 42' which 'cuts off drawing and the laminating bar 40 for coil 28A from a winding frame 21, and turns the line of the adhesives upward, arranges it so that a bar 40 may be stood on the side, and is shown in drawing 27'.

[0034] As shown in drawing 28, laminating tile 42" is attached on the base 51 of a pole piece, as the direction of a laminating becomes a perpendicular (that is, perpendicular to the imaginary line between bottom magnet 72' and the top magnet 72) to the direction of magnetic flux. The advantage of this example is that an eddy current and the hysteresis effect decrease while the stability of a magnetic field becomes high. As shown in drawing 29, laminating tile 42" can be attached on the edge of another pole piece member 90, and, instead, the leak of lateral magnetic flux can be reduced. Member 90 the very thing may consist of multilayer tiles 42 which have the layer by which the laminating was carried out in the direction parallel (that is, it is perpendicular to the direction of a laminating of tile 42") to the direction of magnetic flux. In still more nearly another one aspect of the 3rd example, as shown in drawing 30, coil 28A which has not operated orthopedically can be attached in a base 51, and it can be made the circumferencial direction portion of a pole piece. Coil 28A encloses another pole piece member 90 which can be constituted from other laminating tiles.

[0035] In the 4th example of this invention, the laminating tile of each other with which the 90 degrees of the directions of a laminating differ can be attached. Such a configuration improves the uniformity of the magnetic field in a crevice 73. For example, the laminating tile 42 can be attached in laminating tile 42", and the combination tile 91 shown in drawing 31 can be formed. Instead two tile 42" can be attached and combination tile 91' shown in drawing 32 can be formed. Of course, the 90 degrees of the direction of a laminating can be leaned mutually, and two tiles 42 can also be attached. The combination tile 91 and 91' can turn the field of arbitration to the crevice 73 between MRI equipment, and can attach it in the base 51 of a pole piece.

[0036] The laminating pole piece described above was made from the amorphous metal. However, a metal does not need to be amorphous and may have the crystal structure. A metal can consist of steel, iron, silicon steel or iron (namely, silicon steel of non-orientation), nickel steel or iron, par MENDEYURU (FeCoV), nickel-chromium steel or iron, aluminum steel or iron, aluminum chrome steel, iron, or a material of other arbitration with small holding power. Furthermore, the pole piece by this invention can consist of laminating tiles of a different material listed before. In other words, you may consist of metals with which the adjoining tiles differ. It can constitute from a tile according to

individual made from a different metal which also listed the compound tile 91 and 91' before.

[0037] The laminating tile suitable for the pole piece of MRI equipment was explained. However, how to use the others of a laminating tile, the laminating tile manufacture method, and equipment is also within the limits of this invention. Furthermore, it is sometimes advantageous to use the laminating bar 40, without operating a bar orthopedically to a trapezoid depending on a use. In this case, it can be considered that the laminating bar 40 is the "laminating tile" as used in the field of this invention.

[0038] Although this invention was explained in detail about the specific example, probably, it will be clear to this contractor that various modification can be added to this example, without deviating from the range of this invention.

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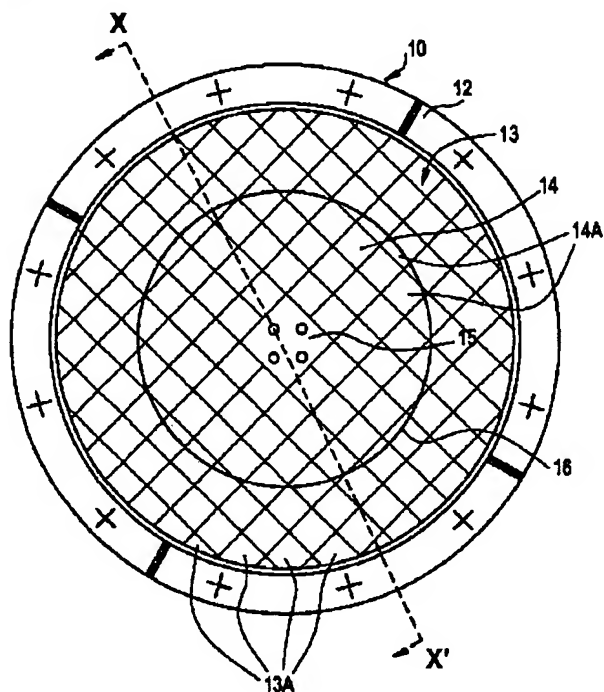
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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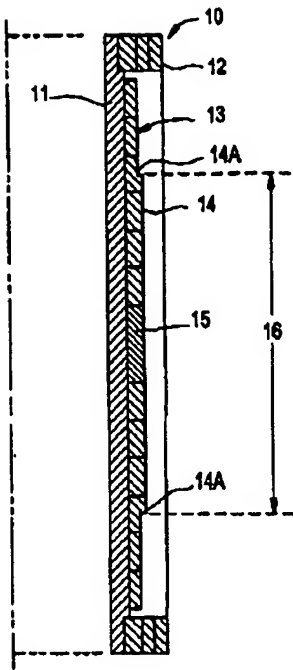
**DRAWINGS**

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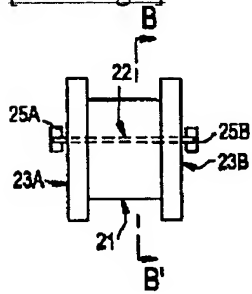
[Drawing 1]



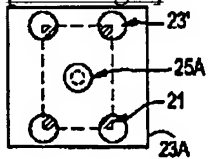
[Drawing 2]



[Drawing 4]



[Drawing 5]



[Drawing 6]



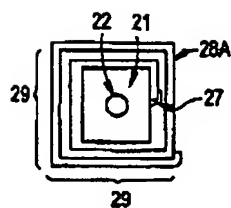
[Drawing 7]



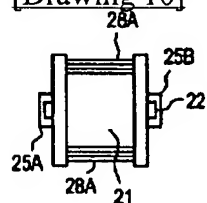
[Drawing 8]



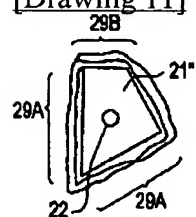
[Drawing 9]



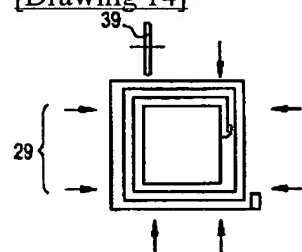
[Drawing 10]



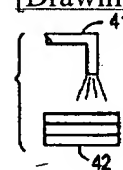
[Drawing 11]



[Drawing 14]



[Drawing 16]



[Drawing 17]



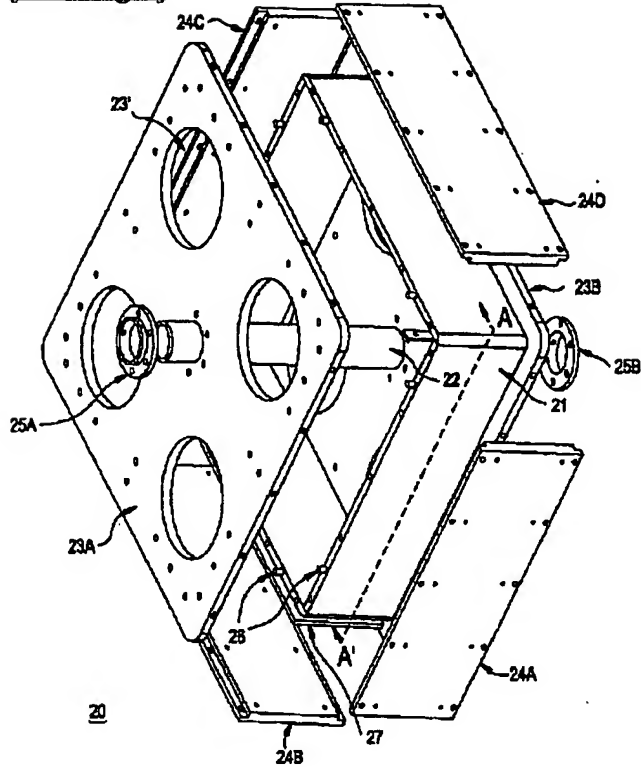
[Drawing 18]



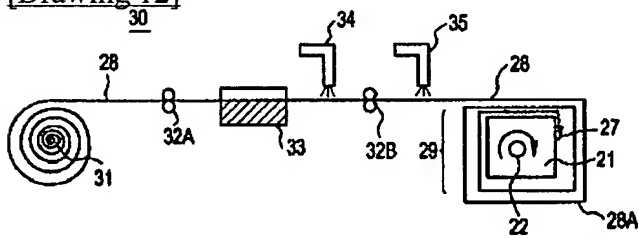
[Drawing 19]



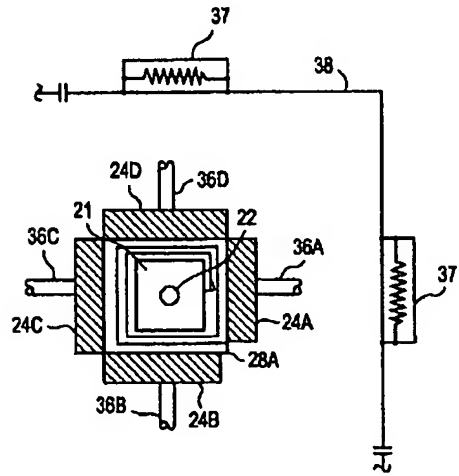
[Drawing 3]



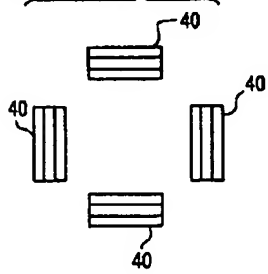
[Drawing 12]



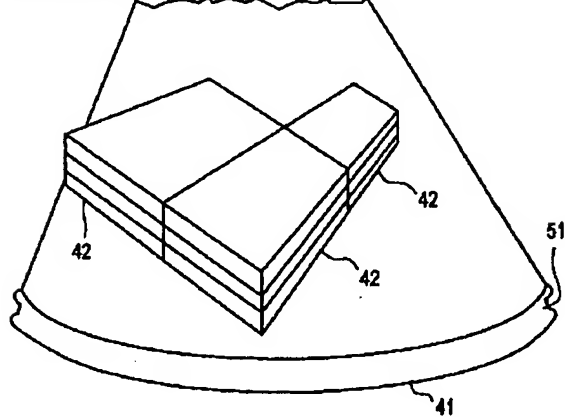
[Drawing 13]



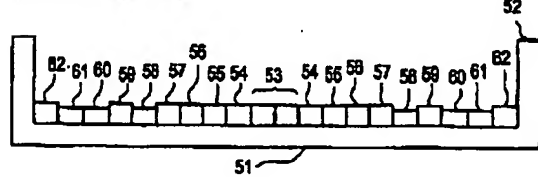
[Drawing 15]



[Drawing 20]

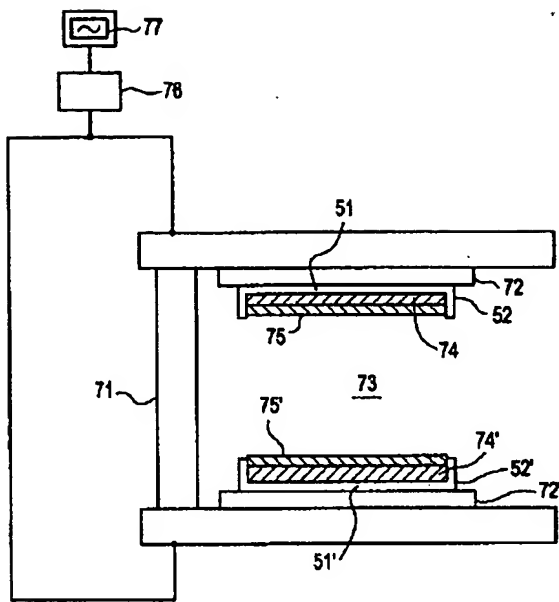


[Drawing 22]

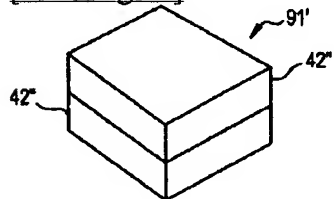


[Drawing 24]

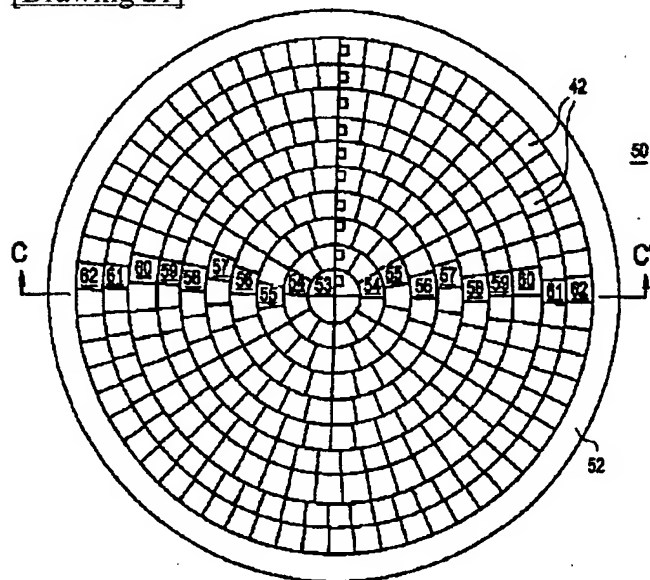




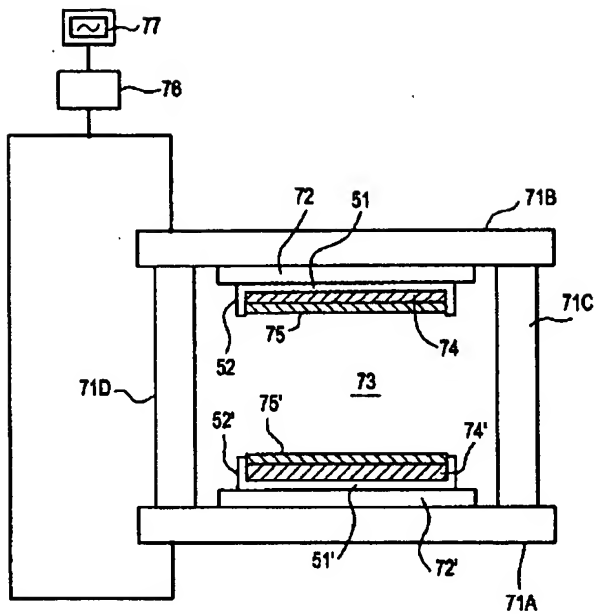
[Drawing 32]



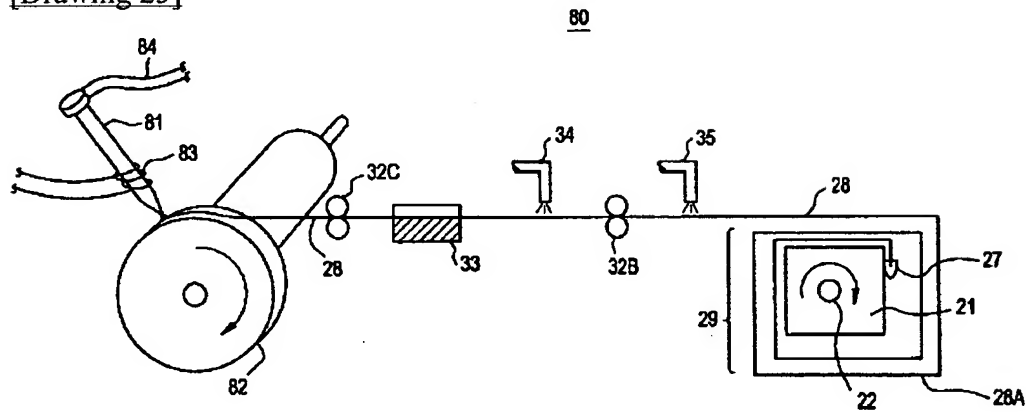
[Drawing 21]



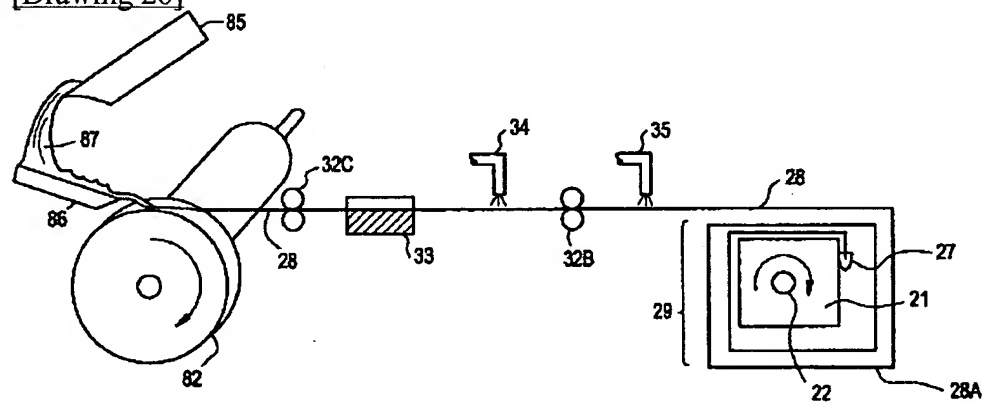
[Drawing 23]



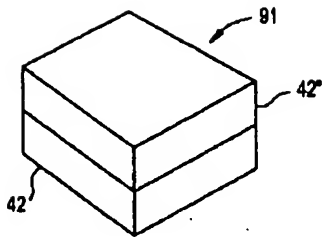
[Drawing 25]



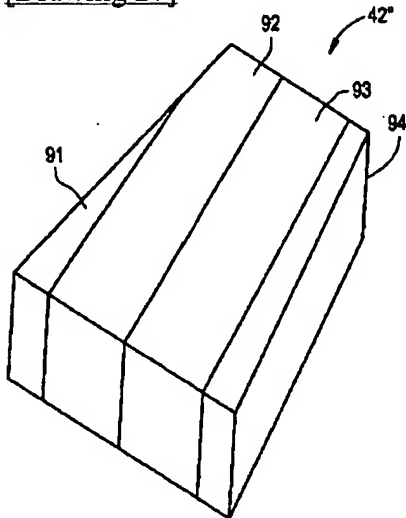
[Drawing 26]



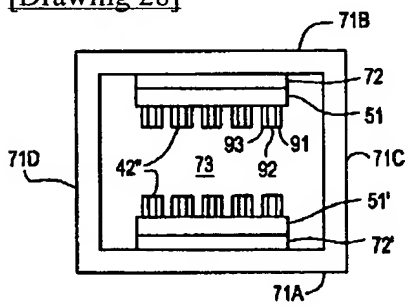
[Drawing 31]



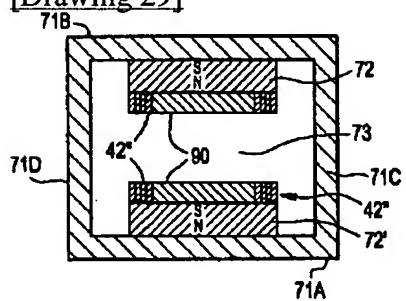
[Drawing 27]



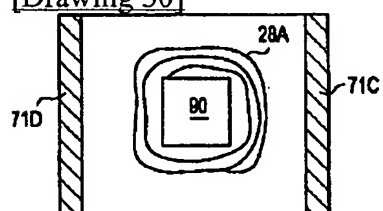
[Drawing 28]



[Drawing 29]



[Drawing 30]



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[Translation done.]